

- II. "The Specific Volumes of Oxygen and Nitrogen Vapour at the Boiling Point of Oxygen." By Professor J. DEWAR, F.R.S.
- III. "The Distribution of Magnetism as affected by Induced Currents in an Iron Cylinder when rotated in a Magnetic Field." By Professor ERNEST WILSON. Communicated by Sir WILLIAM PREECE, K.C.B., F.R.S.
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"The Chemical Origins of the Lines in Nova Persei." By Sir NORMAN LOCKYER, K.C.B., F.R.S. Received December 23, 1901,—Read January 30, 1902.

In the first two papers* which I communicated to the Royal Society on the observations of Nova Persei at Kensington, a general description of the spectrum in its earliest stages was given, and also a statement as to the probable origins of some of the strongest lines, depending upon a comparison of the Nova Spectrum with those of α Cygni, α Canis Majoris, γ Orionis, &c.

A table showing the results of the detailed reduction and discussion of the bright lines in the best spectrum typical of the Nova in this early stage (that obtained with the 6-inch objective prism on February 25, when the star was nearly as bright as Capella), was undertaken later for inclusion in a general summary of the observations in course of preparation.

As various conclusions as to the chemical origin of some of the Nova lines have recently been published which differ widely from those arrived at from a careful study of the Kensington photographs, I think it desirable to publish the above-mentioned table at once. A detailed statement of the evidence on which these conclusions as to origin are based, will follow in the general summary before referred to.

That many of the stronger lines in the early spectra of Nova Aurigæ were chromospheric, has been pointed out by several observers, and all agree that there is little difference in the general aspect of the spectrum of Nova Aurigæ and that of Nova Persei at a corresponding stage of development. In confirmation of this it may be said that by means of direct comparison of the various Kensington photographs, the identity of most of the strong bright Nova bands with lines of α Cygni and the chromosphere—already known to be due to enhanced lines of certain metals—has been established.

With regard to the stellar relations of the Nova, I may state that in my note of February 28,† the agreement in position of its lines with

* 'Roy. Soc. Proc.,' vol. 68, p. 119 and p. 142.

† 'Roy. Soc. Proc.,' vol. 68, p. 121.

Comparison Table of Bright Lines in the Spectra of Nova Persei and Nova Aurigæ with α Cygni Lines, Chromospheric Lines, and the Enhanced Lines of some of the Metals.

Nova Persei (Kensington).		Nova Aurigæ.		α Cygni.	Chromo- sphere (1898 Eclipse).	Enhanced lines.		Remarks.
λ of middle of line.	Description of line.	Campbell.	Vogel.			λ .	Sub- stance.	
3836	Very broad, weak	—	3885	—	3835·6	—	—	H η .
3889	Very broad. ? Narrow reversal in centre	—	3889	3889·1	3889·1	—	—	H ζ .
3934	Broad, rather weak. Fine narrow reversal in centre	—	3934	3933·8	3933·83	3933·83	pCa	K(Ca).
3969	Very broad and fairly strong; shows fine narrow reversal in position of H(Ca) and possibly another weaker one in position of H ϵ	—	3969	{ 3968·6 3970·2	{ 3968·63 3970·25	3968·63	pCa	H(Ca) + H ϵ .
3982	{ All these are very weak diffuse lines which can just be seen with the unaided eye, but which will not bear any mag- nification, and their wave- lengths can only be roughly determined	—	—	4002·7	—	4002·77	pFe	
4003		—	—	4028·5	4028·5	4028·50	pTi	
4019		—	4067	4067·3	4067·3	4067·30	pNi	Strongest enhanced line of Ni.
4029		—	—	4077·9	4077·9	4077·88	pSr	
4067		4082	4095	4101·8	4101·9	—	—	H δ .
4102	Broad and strong	4102	4108					

Comparison Table—*continued*.

Nova Persei (Kensington).		Nova Aurigæ.		α Cygni.	Chromo- sphere (1898 Eclipse).	Enhanced lines.		Remarks.
λ of middle of line.	Description of line.	Campbell.	Vogel.			λ .	Sub- stance.	
4128	Very broad and merging into H δ	4126	4125	$\left\{ \begin{array}{l} 4128 \cdot 1 \\ 4131 \cdot 1 \end{array} \right.$	—	$\left\{ \begin{array}{l} 4128 \cdot 1 \\ 4131 \cdot 1 \end{array} \right.$	$\left. \begin{array}{l} p\text{Si} \\ p\text{Si} \end{array} \right\}$	
4175	Broad and fairly strong	4166 4180 4209	4158 4176	$\left\{ \begin{array}{l} 4163 \cdot 8 \\ 4173 \cdot 5 \\ 4179 \cdot 0 \end{array} \right.$	$\left. \begin{array}{l} 4163 \cdot 8 \\ 4173 \cdot 5 \\ 4179 \cdot 0 \end{array} \right.$	$\left. \begin{array}{l} 4163 \cdot 82 \\ 4173 \cdot 52 \\ 4178 \cdot 95 \end{array} \right.$	$\left. \begin{array}{l} p\text{Ti} \\ p\text{Fe} \\ p\text{Fe} \end{array} \right\}$	Mean λ of enhanced double = 4176.23.
4232	Broad, but not very strong	$\left. \begin{array}{l} 4227 \\ 4236 \end{array} \right\}$	4230	4233.3	4233.3	4233.25	$p\text{Fe}$	
4247	Comparatively narrow, but merging into the broader 4282 line, slightly stronger than the latter	4246	—	4247.2	4247.0	4247.00	$p\text{Sc}$	Strongest spark line of Sc.
4262	Narrow, but fairly strong	4267	4262 4288	$\left. \begin{array}{l} 4262 \cdot 2 \\ 4290 \cdot 4 \end{array} \right.$	—	$\left. \begin{array}{l} 4262 \cdot 15 \\ 4290 \cdot 38 \end{array} \right.$	$\left. \begin{array}{l} p\text{Cr} \\ p\text{Ti} \end{array} \right\}$	
4300	Broad line, fairly strong	4296	—	$\left\{ \begin{array}{l} 4296 \cdot 7 \\ 4300 \cdot 2 \\ 4303 \cdot 3 \end{array} \right.$	$\left. \begin{array}{l} 4296 \cdot 7 \\ 4300 \cdot 2 \\ 4303 \cdot 0 \end{array} \right.$	$\left. \begin{array}{l} 4296 \cdot 65 \\ 4300 \cdot 21 \\ 4303 \cdot 34 \end{array} \right.$	$\left. \begin{array}{l} p\text{Fe} \\ p\text{Ti} \\ p\text{Fe} \end{array} \right\}$	Mean λ of enhanced Fe double = 4300.
4314	Comparatively narrow, merging into 4300	4316	4315	4315.1	$\left\{ \begin{array}{l} 4314 \cdot 0 \\ 4315 \cdot 1 \end{array} \right.$	4315.14	$p\text{Ti}$	Possibly due to Sc 4314.26, one of the strongest spark lines.
4341	Broad and very strong. Doubt- ful reversal in centre	$\left. \begin{array}{l} 4331 \cdot 3 \\ 4340 \cdot 6 \\ 4347 \cdot 8 \end{array} \right\}$	4341	4340.7	4340.7	—	—	H γ .
		4355 4375 4385	—	—	4355 4374.9 4385.5	4374.90 4385.55	$\left. \begin{array}{l} p\text{Ti} \\ p\text{Fe} \end{array} \right.$	

Comparison Table—continued.

Nova Persei (Kensington).		Nova Aurigæ.		α Cygni.	Chromo- sphere (1898 Eclipse).	Enhanced lines.		Remarks.
λ of middle of line.	Description of line.	Campbell.	Vogel.			λ.	Sub- stance.	
4924	Broad and strong.....	{ 4913 4923 4929 4939 }	4923 } 4925 }	4924·1	4924·1	4924·11	pFe	
5019	" "	{ 5007 5018 5095 5142 }	5016	5018·6	5018·6	5018·63	pFe	
5169	Broad and very strong	{ 5159 5169 5176 5200 }	5167	5169·1	5169·1	5169·07 5169·22 }	pFe	Certainly not the <i>b</i> - group of magne- sium.
*5224	Narrow and weak.	5234	523	—	5234·8			
*5273	" "	{ 5276 5285 }	528	—	{ 5275·1 to 5276·2 }	5276·17	pFe	
5316	Moderately broad and strong....	{ 5318 5329 5379 }	5317	5316·8	5316·8	5316·79	pFe	
*5420	Weak and rather narrow.	5454	—	—	5527·6	5527·03	pSc	By far the strongest spark line of Sc in the visual region.
*5475	Weak and narrow.	5535	—	—				
*5530	Fairly strong and broad							

*5575	"	"	5575 } 5584 } 5630 } 5685 } 5761 } 5841 } 5885 } 5896 }	5686†	—	{ 5890.2 } { 5896.2 }	—	—	D (Na).	
*5686	"	"								
*5893	"	"								

† As given by Vogel (probably 5886).

Note.—The lines marked * cannot be seen in the photographs taken with the 6-inch prismatic camera, and their positions have been reduced from the spectrum photographed with the 30-inch reflector with a two-prism slit spectroscope.

those of α Cygni was pointed out. Later, Mr. McClean* confirmed this, and further stated that the bright lines of η Argus corresponded with the dark lines of the Nova; while later still, Sir David Gill† has shown the similarity between the spectra of η Argus and Nova Aurigæ. Hence we are led to the conclusion that the temperatures reached in the outbursts of both these Novæ were not greatly different from those of the stars named, and that in η Argus there are constant conditions which are similar to those temporary conditions which produce the appearance of Novæ.

In the table the lines of Nova Persei are compared with those recorded by Campbell‡ and Vogel§ in Nova Aurigæ.

The probably corresponding lines of α Cygni, chromospheric lines, and enhanced lines, are also given in separate columns.

The reduction to wave-lengths and discussion of the lines in relation to those of other celestial and terrestrial spectra, has been undertaken by Mr. F. E. Baxandall, to whom my best thanks are due.

“The Specific Volumes of Oxygen and Nitrogen Vapour at the Boiling-point of Oxygen.” By JAMES DEWAR, M.A., D.Sc., LL.D., F.R.S. Received January 21,—Read January 30, 1902.

In my paper on “The Boiling-point of Liquid Hydrogen determined by Hydrogen and Helium Gas Thermometers”|| it was pointed out that a constant-volume gas-thermometer filled with oxygen gas, having a pressure at 0° C. of about 800 mm., gave a very accurate value of the boiling-point of liquid oxygen. As it seemed advisable to confirm this result indirectly, an attempt was made to determine the vapour density of oxygen at its boiling-point by direct weighing, the intention being, if the experimental results proved at all encouraging, to repeat the work on a larger scale and with greater precautions. As at present there is no likelihood of my being able to undertake the more accurate determinations, the results of the preliminary enquiry are presented to the Society. They give in any case, with considerable accuracy, the Specific Volumes which have never been directly determined.

In order to obviate any question of the buoyancy of the air, two flasks A and B of as nearly as possible the same air displacement were counterpoised on an Ertling balance. The B flask remained per-

* ‘M.N., R.A.S.,’ vol. 61, p. 387.

† ‘Roy. Soc. Proc.,’ vol. 68, p. 457.

‡ ‘Ast. and Ast. Phys.,’ vol. 11, p. 808.

§ ‘Ast. and Ast. Phys.,’ vol. 12, p. 912.

|| ‘Roy. Soc. Proc.,’ vol. 68, 1901.